Exam Number:

Set:

Shore

Year 12
Term II Examination
May 2014

Mathematics

General Instructions

- Reading time − 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Board–approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- In Questions 11–16, show relevant mathematical reasoning and/or calculations
- Start each of questions 11–16 in a new writing booklet
- Write your examination number on the front cover of each booklet to be handed in
- If you do not attempt a question, submit a blank booklet marked with your examination number and "N/A" on the front cover

Total marks − 100

Section I Pages 2–5

10 marks

- Attempt questions 1–10
- Allow about 15 minutes for this section

Section II Pages 6–13

90 marks

- Attempt questions 11–16
- Allow about 2 hours and 45 minutes for this section

Note: Any time you have remaining should be spent revising your answers.

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Section I

10 marks
Attempt Questions 1−10
Allow about 15 minutes for this section

Use the multiple–choice answer sheet for Questions 1–10.

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1 It is known that for a pair of rational values a and b, $\dfrac{2}{2+\sqrt{3}} = a + b\sqrt{3}$.

What is the value of a?

(A) $a = -4$

(B) $a = -2$

(C) $a = 2$

(D) $a = 4$

2 For what value of x does $a^{2x+1} = \dfrac{1}{a^3}$?

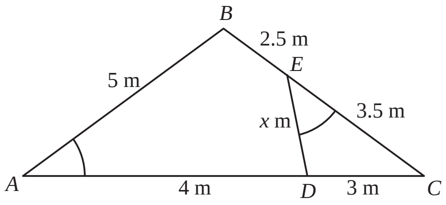
(A) $x = -2$

(B) $x = -\dfrac{1}{2}$

(C) $x = 1$

(D) $x = 2$

3 In the diagram below $\angle CAB = \angle DEC$. What is the value of x?



NOT TO SCALE

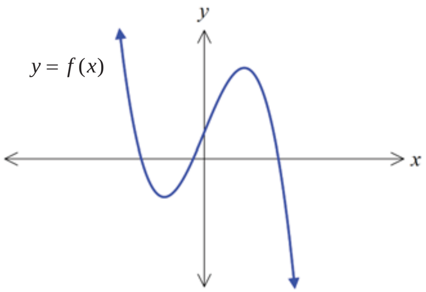
(A) 2.5

(B) 2.8

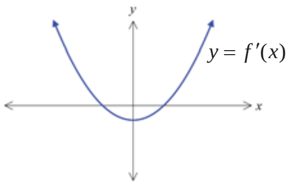
(C) 3.6

(D) 4.375

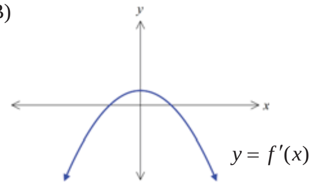
4 Which of the following graphs is a possible gradient function of the function drawn below?



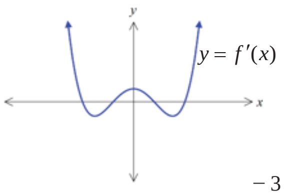
(A)



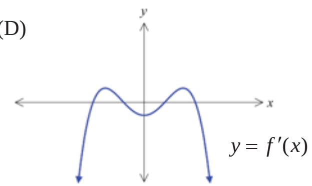
(B)



(C)



(D)



5 What is the value of $\log_{16} 32$?

(A) $\frac{1}{2}$

(B) $\frac{4}{5}$

(C) $\frac{5}{4}$

(D) 2

6 Which of the following expressions correctly uses Simpson's rule to approximate $\int_1^5 \frac{dx}{x}$ using 5 function values?

(A) $\frac{1}{3}\left[\left(\frac{1}{1}+\frac{1}{5}\right)+4\left(\frac{1}{2}+\frac{1}{4}\right)+2\left(\frac{1}{3}\right)\right]$

(B) $\frac{3}{2}\left[\left(\frac{1}{1}+\frac{1}{5}\right)+4\left(\frac{1}{2}+\frac{1}{4}\right)+2\left(\frac{1}{3}\right)\right]$

(C) $\frac{3}{2}\left[\left(\frac{1}{1}+\frac{1}{5}\right)+2\left(\frac{1}{2}+\frac{1}{4}\right)+4\left(\frac{1}{3}\right)\right]$

(D) $\frac{1}{3}\left[\left(\frac{1}{1}+\frac{1}{5}\right)+2\left(\frac{1}{2}+\frac{1}{4}\right)+4\left(\frac{1}{3}\right)\right]$

7 What is the primitive of $3x^2 - \frac{1}{x^2}$?

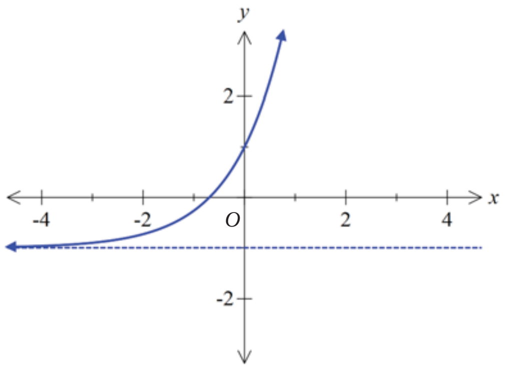
(A) $x^3 - x^{-1} + C$

(B) $6x + 2x^{-3} + C$

(C) $x^3 + x^{-1} + C$

(D) $x^3 - \ln x + C$

8 Which of the following is a possible equation for the graph drawn below?



(A) $y = e^{2x} - 1$

(B) $y = 1 - 2e^{x}$

(C) $y = 2e^{-x} - 1$

(D) $y = 2e^{x} - 1$

9 Consider geometric series $1 - 2 + 4 - 8 + 16 - \ldots$
The sum to n terms of this series is 2 796 203. For what value of n is this true?

(A) 21

(B) 22

(C) 23

(D) no possible value.

10 What is the equation of the directrix for the parabola $(x-2)^2 = -20(y+1)$?

(A) $y = -3$

(B) $y = 4$

(C) $x = 6$

(D) $x = 7$

Section II

90 marks
Attempt Questions 11−16
Allow about 2 hours and 45 minutes for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

In Questions 11–16, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use a SEPARATE writing booklet.

(a) Evaluate, correct to 3 significant figures, $\dfrac{\sqrt{\pi} - 1}{\sin 30^\circ}$. **2**

(b) Factorise $x^2 - 1 - ax - a$. **2**

(c) Find the gradient of the tangent to the curve $y = 4\ln x$ at the point where $x = e^2$. **2**

(d) Show that $f(x) = \dfrac{x^2 + 2}{x}$ is an odd function. **2**

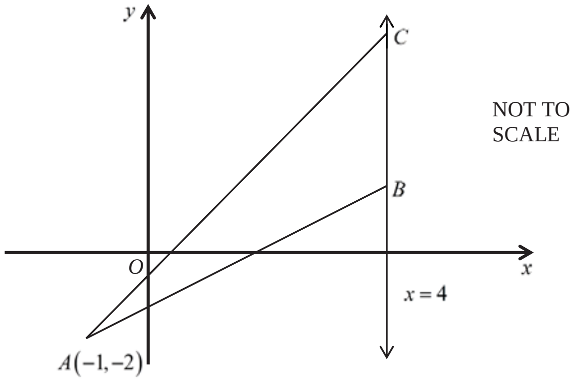
(e) Find the equation of the line that passes through the point $(1, 2)$ and is perpendicular to $2x - y + 3 = 0$. **2**

(f) Find the values of x for which the geometric series $(1-x) + (1-x)^2 + (1-x)^3 + \ldots$ has a limiting sum? **3**

(g) Find $\int (e^{5x+4} - 2)\, dx$. **2**

Question 12 (15 marks) Use a SEPARATE writing booklet.

(a) The points, A, B and C are shown on the number plane below. The point A has coordinates $(-1,-2)$. Points B and C lie on the line $x = 4$.



(i) The equation of the line AB is given as $3x - 5y - 7 = 0$. **1**
Show that the point B has coordinates $(4,1)$.

(ii) Given the area of ΔABC is 22.5 units^2, find the length of AC. **3**

(b) The quadratic equation $y = x^2 - \sqrt{2}x - 2$ has the roots α and β.

(i) Find $\alpha + \beta$. **1**

(ii) Find $\alpha\beta$. **1**

(iii) Find $\alpha^2 + \beta^2$ **2**

Question 12 continues on page 8

(c) Differentiate $y = \dfrac{x^2}{e^{3x}}$ with respect to x. Write your answer in simplest form. **3**

(d) (i) Differentiate $y = \sqrt{16 - x^2}$ with respect to x. **2**

(ii) Hence, or otherwise, find $\displaystyle\int \frac{2x}{\sqrt{16 - x^2}}\,dx$. **2**

End of Question 12

Question 13 (15 marks) Use a SEPARATE writing booklet.

(a) Samantha's parents opened a bank account for her when she was born and deposited \$1 in it. They deposited \$2 on her first birthday, \$4 on her second birthday and so on, with the deposits doubling each birthday. The parents discontinued making deposits after they made a deposit exceeding a million dollars. **3**

On what birthday did the deposit exceed a million dollars?

(b) Find $\int_0^4 x^3 + \frac{1}{\sqrt{x}}\,dx$. **3**

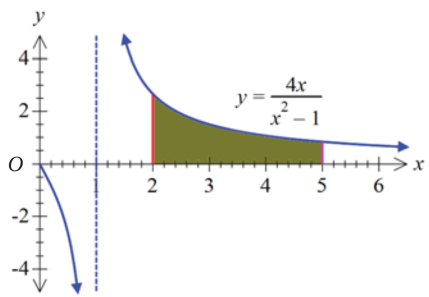
(c) Evaluate $\lim_{x \to 3} \frac{3-x}{x^2-9}$. **2**

(d) Everyonetown had a population of 50 000 people on the 1st of January 2009. The population has grown at a constant rate of 9% every year.

(i) What was the population of Everyonetown on the 1st of January 2014? **2**

(ii) If this population continues to grow at 9% every year, in what year will the population first exceed 100 000 people? **2**

(e) Find the exact value of the area between the curve $y = \frac{4x}{x^2-1}$, the x–axis and the lines $x = 2$ and $x = 5$. **3**



Question 14 (15 marks) Use a SEPARATE writing booklet.

(a) Consider the parabola $y^2 - 2y = 12x - 37$.

(i) Rewrite this equation in the form $(y-k)^2 = 4a(x-h)$. **2**

(ii) Hence sketch the graph of the parabola $y^2 - 2y = 12x - 37$, showing the coordinates of the focus. **2**

(b) Consider the function $f(x) = x(x-3)^2$.

(i) Show that $f'(x) = 3(x-3)(x-1)$. **1**

(ii) Find all stationary points on $y = f(x)$ and determine their nature. **3**

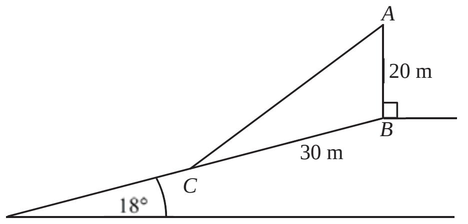
(iii) Draw a neat sketch of $y = f(x)$, showing all intercepts and stationary points. **2**

(c) A function $f(x)$ has a second derivative $f''(x) = 36x + 6$. Find the equation of $f(x)$ if $y = f(x)$ has a stationary point at $(0,-1)$. **3**

(d) Solve $|x+1| = |2x-2|$. **2**

Question 15 (15 marks) Use a SEPARATE writing booklet.

(a) A radio mast *AB*, of height 20 metres, stands at the top of a slope which is inclined at $18°$ to the horizontal. The mast is supported by the wire *AC* which is attached to the point *C* on the slope. *BC* = 30 metres.

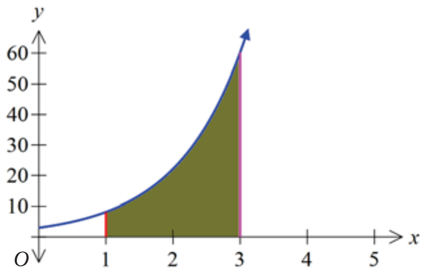


(i) Calculate the size of $\angle ABC$. **1**

(ii) Find the length of the wire *AC*. Write your answer correct to the nearest metre. **2**

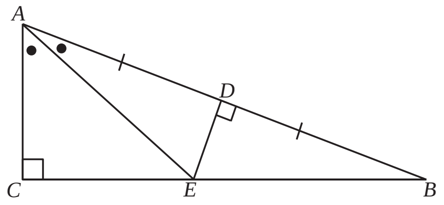
(b) Show that $\tan^2 x + 1 + \tan x \sec x = \dfrac{1+\sin x}{\cos^2 x}$. **2**

(c) The area under the curve $y = 3e^x$ between the values of $x = 1$ and $x = 3$ is rotated about the *x*-axis. Find the exact volume of the solid of revolution formed. **3**



Question 15 continues on page 12

(d) The diagram below shows a right–angled triangle *ABC* with $\angle ACB = 90°$. The point *D* is the midpoint of *AB*, and *E* is the point where the perpendicular drawn from *D* meets *BC*. *AE* bisects $\angle DAC$.



Copy or trace the diagram into your booklet.

(i) Prove that $\Delta ADE \equiv \Delta BDE$. **2**

(ii) Show that $\angle ABC = 30°$. **2**

(iii) Hence find the exact ratio *CB* : *EB*. **3**

End of Question 15

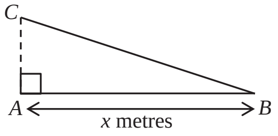
Question 16 (15 marks) Use a SEPARATE writing booklet.

(a) Stephanie borrowed \$50 000 to start a business. For the first year of the loan Stephanie made no repayments. The loan accrued interest at 9% per annum, compounded monthly. Stephanie then made equal monthly instalments of \$*M* for the next 5 years. Let A_n be the amount owing after *n* months.

(i) Show that the amount owing after 15 months is given by $A_{15} = 50\,000(1.0075)^{15} - M\left(1 + 1.0075 + 1.0075^2\right)$. **2**

(ii) Calculate Stephanie's monthly repayment of \$*M* correct to the nearest cent. **3**

(b) A wire of length 10 metres is bent to form the hypotenuse and base of a right angled triangle *ABC*, as shown in the diagram below. Let the length of the base *AB* be *x* metres.



NOT TO SCALE

(i) Show that the area of the triangle *ABC* in square metres is given by $A = \frac{x}{2}\sqrt{100 - 20x}$. **2**

(ii) Find the value of *x* that gives the greatest possible area. **3**

(c) Consider the graphs $y = \sqrt{x}$ and $y = mx$, where m is a constant such that $m > 0$.

(i) Show that the two graphs intersect at $(0,0)$ and $\left(\frac{1}{m^2}, \frac{1}{m}\right)$. **2**

(ii) Hence find the area enclosed by the two graphs in terms of m. **3**

End of Paper

Year 12 Mathematics Mid Year Solutions

1) D

$$\frac{2}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}=\frac{2(2-\sqrt{3})}{4-3}$$
$$=4-2\sqrt{3}$$
$$\therefore a=4, b=-2$$

2) A

$$a^{2x+1}=\frac{1}{a^3}$$
$$a^{2x+1}=a^{-3}$$
$$2x+1=-3$$
$$2x=-4$$
$$x=-2$$

3) A

$$\frac{x}{5}=\frac{3}{6}$$
$$x=2.5$$

4) B

5) C

$$2^5=2^{4x}$$
$$5=4x$$
$$x=\frac{5}{4}$$

or

$$\log_{16}32=x$$
$$32=16^x$$
$$\ln(32)=x\ln(16)$$
$$x=\frac{\ln(32)}{\ln(16)}$$
$$x=\frac{5}{4}$$

6) A

7) C

$$f(x)=3x^2-\frac{1}{x^2}$$
$$=3x^2-x^{-2}$$
$$\int f(x)dx=\int 3x^2-x^{-2}dx$$
$$=x^3+x^{-1}+C$$

8) D

9) C

$$1-2+4-8+16-\ldots$$
$$a=1,\ r=-2,\ S_n=2796203$$
$$S_n=\frac{a(r^n-1)}{r-1}$$
$$2796203=\frac{1((-2)^n-1)}{-2-1}$$
$$-8388609=(-2)^n-1$$
$$-8388608=(-2)^n$$
$$(-1)8388608=(-1)^n(2)^n$$
$$n=\frac{\ln(8388608)}{\ln(2)}\text{ for } n \text{ odd}$$
$$=23$$

10) B

11)

a) $$\frac{\sqrt{\pi}-1}{\sin 30°}=1.544907702\ldots$$
$$\approx 1.54$$

b) $$x^2-1-ax-a=(x-1)(x+1)-a(x+1)$$
$$=(x+1)(x-1-a)$$

c)
$$y=4\ln x$$
$$\frac{dy}{dx}=\frac{4}{x}$$
$$at\ x=e^2$$
$$\frac{dy}{dx}=\frac{4}{e^2}$$

d)
$$f(x)=\frac{x^2+2}{x}$$
$$f(-x)=\frac{(-x)^2+2}{-x}$$
$$=-\frac{x^2+2}{x}$$
$$=-f(x)$$

e)
$$2x-y+3=0$$
$$y=2x+3$$
$$m_1=2$$
$$m_2=-\frac{1}{2},\text{ through }(1,2)$$
$$y-2=-\frac{1}{2}(x-1)$$
$$2y-4=-x+1$$
$$x+2y-5=0$$

f)
$$(1-x)+(1-x)^2+(1-x)^3+\ldots$$
$$r=(1-x)$$
for limiting sum
$$-1<r<1$$
$$-1<1-x<1$$
$$-2<-x<0$$
$$0<x<2$$

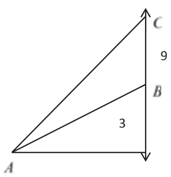
g) $$\int e^{(5x+4)}-2\,dx=\frac{1}{5}e^{(5x+4)}-2x+C$$

12)

a)

i)
$$3x-5y-7=0$$
$$\text{at } x=4$$
$$3(4)-5y-7=0$$
$$12-7=5y$$
$$y=1$$

ii) Area of $\Delta ABC=22.5$
$$22.5=\frac{1}{2}(5)BC$$
$$BC=9$$
$$AC=\sqrt{5^2+(9+3)^2}$$
$$=13\text{ units}$$



b) $$y=x^2-\sqrt{2}x-2$$

i)
$$\alpha+\beta=\frac{-b}{a}$$
$$=\frac{-(-\sqrt{2})}{1}$$
$$=\sqrt{2}$$

ii)
$$\alpha\beta=\frac{c}{a}$$
$$=\frac{-2}{1}$$
$$=-2$$

iii)
$$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$$
$$=(\sqrt{2})^2-2(-2)$$
$$=2+4$$
$$=6$$

c)
$$y=\frac{x^2}{e^{3x}}$$
$$\frac{dy}{dx}=\frac{e^{3x}2x-x^2 3e^{3x}}{e^{6x}}$$
$$=\frac{xe^{3x}(2-3x)}{e^{6x}}$$
$$=\frac{x(2-3x)}{e^{3x}}$$

d)

i)

$$y=\sqrt{16-x^2}$$
$$=\left(16-x^2\right)^{\frac{1}{2}}$$
$$\frac{dy}{dx}=\frac{1}{2}\times\left(16-x^2\right)^{-\frac{1}{2}}\times -2x$$
$$=\frac{-x}{\sqrt{16-x^2}}$$

ii)

$$\int\frac{2x}{\sqrt{16-x^2}}dx$$
$$=-2\int\frac{-x}{\sqrt{16-x^2}}dx$$
$$=-2\sqrt{16-x^2}+C$$

13)

a)

$$T_n=ar^{n-1}$$
$$1000000=1\times 2^{n-1}$$
$$1000000=\frac{2^n}{2}$$
$$2000000=2^n$$
$$n=\frac{\ln(2000000)}{\ln(2)}$$
$$=20.931...$$

$\therefore$ last desposit on her 20th Birthday

b)

$$\int_0^4 x^3+\frac{1}{\sqrt{x}}\,dx$$
$$=\left[\frac{x^4}{4}+2x^{\frac{1}{2}}\right]_0^4$$
$$=\left[\frac{(4)^4}{4}+2(4)^{\frac{1}{2}}\right]-\left[\frac{(0)^4}{4}+2(0)^{\frac{1}{2}}\right]$$
$$=(64+4)-0$$
$$=68$$

c)

$$\lim_{x\to 3}\frac{3-x}{x^2-9}=\lim_{x\to 3}\frac{-(x-3)}{(x+3)(x-3)}$$
$$=\lim_{x\to 3}\frac{-1}{(x+3)}$$
$$=\frac{-1}{(3+3)}$$
$$=-\frac{1}{6}$$

d)

i)

$$P=50000(1+0.09)^5$$
$$=76931.19775$$
$$\approx 76931$$

ii)

$$100000=50000(1.09)^n$$
$$n=\frac{\ln(2)}{\ln(1.09)}$$
$$=8.043231...$$

The population will first exceed 100 000 in 2017

e)

$$A=\int_2^5\frac{4x}{x^2-1}dx$$
$$=2\int_2^5\frac{2x}{x^2-1}dx$$
$$=2\left[\ln\left(x^2-1\right)\right]_2^5$$
$$=2\left[\ln(24)-\ln(3)\right]$$
$$=2\ln 8$$
$$=6\ln 2\text{ units}^2$$

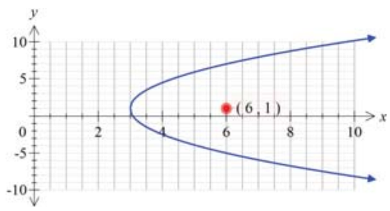
14)

a) $y^2-2y=12x-37$

i)

$$y^2-2y+1=12x-37+1$$
$$(y-1)^2=12x-36$$
$$(y-1)^2=12(x-3)$$

ii)



b)

i)

$$f(x)=x(x-3)^2$$
$$f'(x)=2x(x-3)+(x-3)^2$$
$$=(x-3)[2x+x-3]$$
$$=(x-3)(3x-3)$$
$$=3(x-3)(x-1)$$

ii)

$$f'(x)=3(x-3)(x-1)$$
$$=3x^2-12x+9$$

Stationary points at $f'(x)=0$

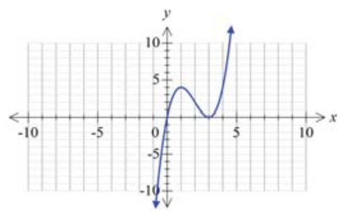
$$x=3\;and\;x=1$$
$$f(1)=1(1-3)^2$$
$$=4$$
$$f(3)=3(3-3)^2$$
$$=0$$
$$f''(x)=6x^2-12$$
$$f''(1)=6(1)^2-12$$
$$=-6$$
$$<0$$

$\therefore$ Maximum Turning point at $(1,4)$

$$f''(x)=6x^2-12$$
$$f''(3)=6(3)^2-12$$
$$=42$$
$$>0$$

$\therefore$ Minimum Turning point at $(3,0)$

iii)



c)

$$f''(x)=36x+6$$
$$f'(x)=\int f''(x)\,dx$$
$$=18x^2+6x+C_1$$
$$f'(0)=0$$
$$0=18(0)^2+6(0)+C_1$$
$$C_1=0$$
$$f'(x)=18x^2+6x$$
$$f(x)=\int f'(x)\,dx$$
$$=6x^3+3x^2+C_2$$
$$f(0)=-1$$
$$-1=6(0)^3+3(0)^2+C_2$$
$$C_2=-1$$
$$\therefore f(x)=6x^3+3x^2-1$$

d)

$$|x+1|=|2x-2|$$

case 1

$$x+1=2x-2$$
$$x=3$$

case 2

$$x+1=-2x+2$$
$$x=\frac{1}{3}$$

test $x=\frac{1}{3}$

$$\therefore x=3, x=\frac{1}{3}$$

15)

a)

i) $\angle ABC = 90° + 18°$

$= 108°$

ii) $AC^2 = (30)^2 + (20)^2 - 2\times 30\times 20\cos 108°$

$= 1670.820393...$

$AC = 40.87566...$

≈ 41 m

b) $\tan^2 x + 1 + \tan x \sec x = \dfrac{1+\sin x}{\cos^2 x}$

$LHS = \tan^2 x + 1 + \tan x \sec x$

$= \dfrac{\sin^2 x}{\cos^2 x} + \dfrac{\cos^2 x}{\cos^2 x} + \dfrac{\sin x}{\cos x}\times\dfrac{1}{\cos x}$

$= \dfrac{1+\sin x}{\cos^2 x}$

$= RHS$

c) $y = 3e^x$

$y^2 = (3e^x)^2$

$= 9e^{2x}$

$V = \pi\int_1^3 9e^{2x}\,dx$

$= \pi\left[\dfrac{9e^{2x}}{2}\right]_1^3$

$= \pi\left[\dfrac{9e^{2(3)}}{2} - \dfrac{9e^{2(1)}}{2}\right]$

$= \dfrac{9\pi(e^6 - e^2)}{2}$ units^2

$= \dfrac{9\pi e^2(e^4 - 1)}{2}$ units^2

d)

i) $\Delta ADE \equiv \Delta BDE$

$AD = BD$ (Given)

$DE = DE$ (Common)

$\angle ADE = \angle BDE = 90°$

$\therefore \Delta ADE \equiv \Delta BDE$ (SAS)

ii) $\angle CAE = \angle EAD$ (AE bisects $\angle BAC$)

let $\angle CAE = \alpha$

$\angle EAD = \angle EBD$ (matching angles in congruent triangles)

$3\alpha = 90°$ (Angle sum of a triangle ABC)

$\alpha = 30°$

$\angle ABC = 30°$

iii) let $AB = 2$

$\sin 30° = \dfrac{AC}{2}$

$AC = 1$

$CB = \sqrt{2^2 - 1^2}$

$= \sqrt{3}$

$DB = 1$

$\cos 30° = \dfrac{1}{EB}$

$EB = \dfrac{2}{\sqrt{3}}$

$CB : EB$

$\sqrt{3} : \dfrac{2}{\sqrt{3}}$

$3 : 2$

16)

a)

i) $A_1 = 50\,000(1.0075)^1$

$A_{12} = 50\,000(1.0075)^{12}$

$A_{13} = 50\,000(1.0075)^{13} - M$

$A_{14} = \left[50\,000(1.0075)^{13} - M\right](1.0075) - M$

$A_{14} = 50\,000(1.0075)^{14} - M(1 + 1.0075)$

$A_{15} = 50\,000(1.0075)^{15} - M(1 + 1.0075 + 1.0075^2)$

ii) $A_{72} = 50\,000(1.0075)^{72} - M(1 + 1.0075 + ... + 1.0075^{59})$

$A_{72} = 0$

$M = \dfrac{50\,000(1.0075)^{72}}{1 + 1.0075 + ... + 1.0075^{59}}$

$1 + 1.0075 + ... + 1.0075^{59} = \dfrac{1(1.0075^{60} - 1)}{0.0075}$

$M = \dfrac{50\,000(1.0075^{72})}{1.0075^{60} - 1}\times 0.0075$

$M = \dfrac{375(1.0075^{72})}{1.0075^{60} - 1}$

$= \$1135.28$

b)

i) $AC = \sqrt{(10-x)^2 - x^2}$

$= \sqrt{100 - 20x + x^2 - x^2}$

$= \sqrt{100 - 20x}$

$Area\ \triangle ABC = \dfrac{1}{2}x\sqrt{100-20x}$

$= \dfrac{x}{2}\sqrt{100-20x}$

ii) $A = \dfrac{x}{2}\sqrt{100-20x}$

$= \dfrac{x(100-20x)^{\frac{1}{2}}}{2}$

$\dfrac{dA}{dx} = \dfrac{-10x}{\sqrt{100-20x}} + \dfrac{\sqrt{100-20x}}{2}$

$= \dfrac{-10x + (100-20x)}{2\sqrt{100-20x}}$

Stat points at $\dfrac{dA}{dx} = 0$

$0 = \dfrac{-10x + (100-20x)}{2\sqrt{100-20x}}$

$0 = 100 - 30x$

$x = \dfrac{10}{3}m$

x	3	$\frac{10}{3}$	4
$\frac{dA}{dx}$	$\frac{-10(3)+(100-20(3))}{2\sqrt{100-20(3)}}$ $= \frac{-30+40}{2\sqrt{40}}$ > 0	0	$\frac{-10(4)+(100-20(4))}{2\sqrt{100-20(4)}}$ $= \frac{-40+20}{2\sqrt{40}}$ < 0
	/	—	\

Therefore max area when $x = \dfrac{10}{3}m$.

c)

i)

$$y=\sqrt{x}$$
$$y=mx$$
$$\sqrt{x}=mx$$
$$0=\sqrt{x}-mx$$
$$=x\left(x^{-\frac{1}{2}}-m\right)$$
$$x=0$$
$$\therefore y=0$$
and
$$x^{-\frac{1}{2}}=m$$
$$x=m^{-2}$$
$$=\frac{1}{m^2}$$
$$\therefore y=\sqrt{\frac{1}{m^2}}$$
$$=\frac{1}{m}$$
$\therefore$ The graphs intersect at $(0,0)$ and $\left(\frac{1}{m^2},\frac{1}{m}\right)$.

ii)

$$A=\int_0^{\frac{1}{m^2}}\left(\sqrt{x}-mx\right)dx$$
$$=\left[\frac{2x^{\frac{3}{2}}}{3}-\frac{mx^2}{2}\right]_0^{\frac{1}{m^2}}$$
$$=\left[\frac{2\left(\frac{1}{m^2}\right)^{\frac{3}{2}}}{3}-\frac{m\left(\frac{1}{m^2}\right)^2}{2}\right]-0$$
$$=\frac{2\left(\frac{1}{m^3}\right)}{3}-\frac{\left(\frac{1}{m^3}\right)}{2}$$
$$=\left(\frac{2}{3m^3}\right)-\left(\frac{1}{2m^3}\right)$$
$$=\frac{1}{6m^3}\text{ units}^2$$